NEW CALANOID COPEPODS OF THE FAMILIES AETIDEIDAE, EUCHAETIDAE, AND STEPHIDAE FROM THE GULF OF MEXICO

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The numerous and widespread zooplankton collections made by the United States Fish and Wildlife Service vessel *Alaska* in the Gulf of Mexico between the years 1951–53 offer the first opportunity for a comprehensive account of the epiplanktonic copepods inhabiting the region. Previous studies on this fauna have been confined to limited coastal areas off Florida, Mississippi, and Louisiana (Schmitt 1954). The present investigation of the *Alaska* collections has already revealed a rich and varied fauna occurring in the surface waters of the Gulf. Approximately 100 calanoid species have been identified thus far, including nine previously undescribed populations. Three of these new forms, belonging to the families Aetideidae, Euchaetidae, and Stephidae, respectively, are described in this report.

Family AETIDEIDAE

BRADYIDIUS Giesbrecht

Bradyidius arnoldi, new species

PLATE 1, FIGS. 1–13

Localities, Material.—Gulf of Mexico: lat. 22°20′ N., long. 87°31′ W. (*Alaska*, cruise 4, station 11, 13 January 1952, surface plankton tow, four males); lat. 29°06′ N., long. 93°00′ W. (*Alaska*, cruise 8, station 2, 12 February 1953, 6 m. depth of plankton tow, one female); lat. 25°30′ N., long 97°06′ W. (*Alaska*, cruise 10, station 5, 16 April 1953, 3 m. depth of plankton tow, three immature copepodites).

Measurements.—All measurements made from dorsal view along midsagittal plane; cephalothorax measured from anteriormost margin of forehead to posterior margin of intersegmental fold between thoracic fusion segment IV–V and genital segment; length of abdomen from anterior margin of genital segment to porteriormost limit of right furcal ramus. Measurements made at 100× magnification with aid of ocular micrometer; specimen immersed in aqueous solution of 50 percent glycerine. Slender glass rods used to support cephalothorax and abdomen in horizontal position during measurements of each. Measurements given are total length (TL) and cephalothorax-abdomen length ratio (CAR).

1. ADULT FEMALE: TL 1.67 mm., CAR 4.0:1
2. ADULT MALES: TL 1.23 mm., CAR 2.8:1 (holotype); TL 1.19 mm., CAR 2.8:1; TL 1.23 mm., CAR 2.8:1

NOTE.—Approved for publication November 9, 1956. Fishery Bulletin 117.

Diagnosis.—A species relatively small in size with respect to the genus in which the female closely resembles *B. armatus* Giesbrecht and *B. pacificus* (Brodski), whereas the male is somewhat similar to *pacificus* as well as *B. similis* (Sars).

ADULT FEMALE: Appears to differ only slightly from *armatus* (vide Sars 1902: pls. 20, 21) and *pacificus* (vide Brodski 1950: text fig. 65).

Thorax (figs. 1, 2) with segments IV–V imperfectly fused, weak line of demarcation visible in dorsal view. Posteriormost portion of thoracic segments I–III flared both dorsad and laterad, fused cephalon-segment I flared to greatest extent. Fusion segment IV–V terminating on right and left sides in robust spiniform process, similar to *armatus*, but processes originating more dorsad, tilted dorsad, and with irregular medial and ventral outlines. Anal segment shorter than preceding segment.

First antennae each with 24 segments, as long as cephalothorax less spiniform processes of last segment. Mandible with dentition of gnathal lobe (fig. 6b) differing from that in *armatus;* teeth more numerous, those on ventral half of lobe overlapping. Stage V male copepodite with mandibular gnathal lobe (fig. 6a) apparently similar to that in *armatus*. Second maxillae (fig. 13) with short seta on lobes 2–4, each with closely spaced row of spinules on proximal portion; falcate spine on lobe 5 with closely spaced row of

short fine hairs. Remaining cephalic appendages similar to those in *armatus*.

First legs with external spines of exopodite (Re) unequal; first segment (Re_1) with reduced spine; Re_2 with thick spine barely longer than length of segment; Re_3 with styliform spine about two times length of segment (fig. 8). Remaining legs with dorsal and ventral borders of each external spine bearing fringe of numerous closely spaced hairs (fig. 7).

Endopodite (Ri) of first leg with lateral shoulder broad, truncate, and bearing recurved spinules distad (fig. 8). Legs 2–4 with Ri bearing spinules differing in number and arrangement from those in *armatus*. Leg 2 with proximal portion of Ri_2 bearing arc of four large spinules; distal portion with three pairs of spinules, single spinule between first and second pair (fig. 7). Leg 3 with Ri_2 bearing about 11 subequal spinules arranged along outer half of segment in proximal row of four, distal cluster of seven; Ri_3 with total of about 12 spinules including proximal cluster of seven, two distal rows of three each (fig. 10). Leg 4 with Ri_2 bearing distal cluster of numerous thick hairs and a row of six spinules (fig. 9). Fifth leg lacking as in other species of genus.

ADULT MALE: Differs from *pacificus* and *similis* chiefly in details of fifth legs.

Fifth legs approximately two times total length of abdomen plus furcal rami, almost entire length of Re extending posteriad beyond abdomen (fig. 3). Right Ri unisegmental, less than one-third length of Re_1; Ri with truncate apex bearing short acuminate filament. Right Re with two segments, second segment weakly sclerotized with proximal portion bearing low lamella, distalmost portion expanded. Left Ri two-segmented, about as long as left Re_1; segmentation of left Ri apparently variable in *similis*, bisegmental according to Vanhöffen (1907: pl. 22, fig. 30), unisegmental in Sars (1902: pl. 20). Left Re with three segments; Re_2 bearing distal tuft of styliform spinules; Re_3 hirsute along inner face; Re_2 and Re_3 about equal in length, each shorter than Re_1 (fig. 12).

Types (*cf. Localities*).—All deposited in United States National Museum. Male holotype, No. 99204, selected from material of *Alaska*, cruise 4, station 11. Male paratypes, No. 99205 (*Alaska*, cruise 4, station 11); female paratype, No. 99206 (*Alaska*, cruise 8, station 2).

Further description.—Abdominal segments including furcal rami with following proportional lengths: female (segments 3 and 4 taken together) 39; 19; 20; 22 (=100); male (segments 4 and 5 taken together) 15; 29; 21; 19; 16 (=100).

Female with terminal spines of legs 2–4 bearing 17, 19, 18 serrations, respectively. Leg 4 about one-third longer than abdomen. Rostrum similar to that of *pacificus*.

Male with terminal spiniform processes of thoracic fusion segment IV–V produced posteromediad (fig. 4). First antennae elongated, extending to furcal rami; right antenna with 20 visible segments, primitive segments 8–10, 12–13, 20–21, 24–25 fused. Left antenna with 21 visible segments, primitive segments 20, 21 not fused. Remaining cephalic appendages reduced as in other species of genus. Ri of legs 2–4 with spinules as in female.

Ecology.—There is evidence that the new species differs from previously described members of the genus with respect to temperature requirements. One of the three, *B. pacificus*, is known only from the boreal to subarctic waters of the Sakhalin Sea. The other two, *similis* and *armatus*, appear to range circumglobally from the arctic to the tropics (Rose 1933, Wilson 1950, Vervoort 1952). However, despite the latitude, the three species are typically confined to deep water at or near the ocean bottom (Sars 1902, Brodski 1950, Vervoort 1952). In those instances where collecting data are available for the more infrequent records of the genus from the lower latitudes, *armatus* and *similis* occurred only in vertical tows taken from depths in excess of 200 fathoms (Pacific Ocean: Scott 1909; Wilson 1942, 1950). According to Sverdrup, Johnson, and Fleming (1942: 690–695, fig. 191, chart 5) temperatures at 200 fathoms in tropical latitudes of the Pacific do not exceed 10° C. and, in fact, usually approximate 5°C. or less. It is well known that subsurface temperatures in boreal and arctic waters of the northeastern Atlantic are below 10° C. Therefore, the approximate temperature range of previously described species of the genus would appear to lie between 0°–10° C.

With the new species, water temperatures at the time and depth of capture ranged from a low of

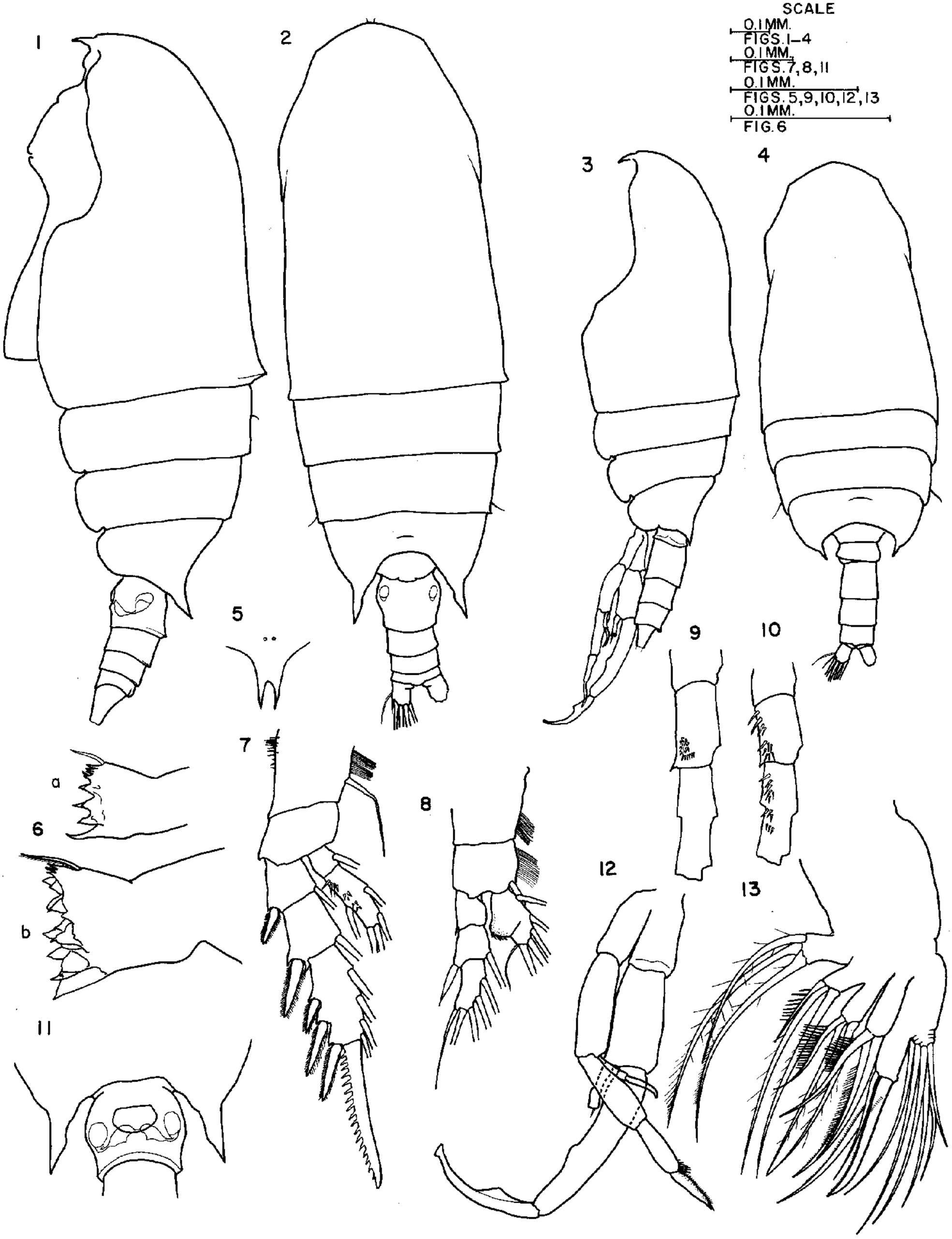

PLATE 1.—*Bradyidius arnoldi*, new species. 1, female, lateral view; 2, female, dorsal view; 3, male, lateral view; 4, male, dorsal view; 5, male rostrum; 6, mandibular gnathal lobe; (a) stage V male; (b) adult female; 7, female second leg; 8, female first leg; 9, female fourth leg, endopodite; 10, female third leg, endopodite; 11, female genital segment, ventral view; 12, male fifth legs; 13, female second maxilla. All figures drawn with aid of camera lucida; figures 3, 4 of holotype, remaining figures of paratypes.

16.7° C. to a high of 23.5° C. The new species occurred only in surface or near-surface night samples taken over the relatively shallow depths of the continental shelf. However, it seems reasonable to suspect that *arnoldi* is more typically a bathypelagic species, as are its congenitors. Considering the nature of the tows containing *arnoldi*, vertical migration could readily account for the temporary presence of the species in surface waters. Regarding subsurface conditions at the time and place of these tows, temperatures were found to be virtually identical at all depths. Therefore, from the available data *arnoldi* occurs at temperatures within the subtropical range whereas its congenitors appear to have been found only in temperatures confined to the cold temperate-boreal range, irrespective of latitude.

Remarks.—The female of the new species is not readily separated from its congenitors, *armatus*, *similis*, and *pacificus*. It appears to be characterized by (1) flaring of the posterior margins of the thoracic segments, (2) the more dorsal origin and the dorsal tilt of the spiniform processes extending from thoracic fusion segment IV–V, and (3) details of the first pair of legs, including a reduced external spine on Re_1, a thick spine on Re_2, and a broad truncate shoulder with recurved spinules on Ri. Other structures may ultimately prove more valuable for identification, such as the mandibular gnathal lobe and the length relation of the fourth leg and the abdomen.

The male is easily distinguished from the other species. The most outstanding character is the relatively great length of the fifth legs, which are approximately twice the length of the abdomen. Furthermore, in the right fifth leg the length of the first segment of the exopodite is considerably greater than that of the endopodite. In *arnoldi* the ratio of these segments is approximately 3.6 : 1, whereas in *pacificus* and *similis* this ratio is about 2.0 : 1, as calculated from Brodski (1950: text fig. 65), Vanhöffen (1907: pl. 22, fig. 30), and Sars (1902: pl. 21). In *armatus* the fifth legs lack endopodites.

Despite the limited degree of morphological characterization and the lack of data on variability, it is proposed that this Gulf of Mexico form be given specific status because (1) the most outstanding character occurs in a sexual structure (i. e., fifth legs of the male) and because (2) it appears to be geographically as well as ecologically separated (i. e., temperature range) from other forms of *Bradyidius*.

This species is named in honor of Edgar L. Arnold (U. S. Fish and Wildlife Service), Fishery Research Biologist, in charge of plankton collecting operations aboard the *Alaska* during its survey of the Gulf of Mexico.

Family EUCHAETIDAE

EUCHAETA Philippi

Euchaeta paraconcinna, new species

PLATE 2, FIGS. 1–16

Localities, Material.—Gulf of Mexico: material obtained from 16 localities within lats. 22°21′–30°00′ N., longs. 82°19′–96°00′ W. at depths of 1–10 m. Plankton tows made during period from January–June, in years 1951–53. (*Alaska:* cruise 1, station 30; cruise 4, stations 28, 36; cruise 8, stations 5, 6, 30, 33, 34, 36; cruise 10, stations 17, 18, 25, 30; cruise 11, stations 16, 23, 24.) Material abundant, in excess of 100 individuals, mostly females.

Onslow Bay, N. C., M/V *Atlantis:* station 178 (May 1953, oblique tow 30–15 m., one female); station 189 (June 1953, oblique tow 20–0 m., one female).

Measurements.—All measurements from dorsal view at 32× magnification; cephalothorax measured along midsagittal plane from apex of frontal organ to posterior margin of intersegmental fold between thoracic fusion segment IV–V and genital segment; length of abdomen from anterior margin of genital segment to articulation between fourth innermost seta and right furcal ramus. Otherwise, methods are as presented under preceding species.

Measurements given include total length (TL) and cephalothorax-abdomen length ratio (CAR). Measurements grouped since variation similar in TL and CAR of specimens from various localities.

1. ADULT FEMALE: 20 specimens selected at random, TL range 2.79–3.23 mm., mean with standard error 3.04±.034 mm., standard deviation 0.146 mm., CAR range 2.3–2.6 : 1, mean 2.4 : 1.

2. ADULT MALE: five specimens selected at random, TL 2.63 mm., CAR 2.7 : 1; TL 2.49 mm., CAR 2.8 : 1; TL 2.56 mm., CAR 2.7 : 1; TL 2.64 mm., CAR 2.8 : 1; TL 2.63 mm., CAR 2.8 : 1.

Diagnosis.—A western Atlantic-Gulf of Mexico population closely resembling an Indo-Pacific congenitor, *E. concinna* Dana, as described by Giesbrecht (1892) and Scott (1909).

ADULT FEMALE: Differs from *concinna* chiefly in details of thoracic fusion segment IV–V and genital segment.

Posterior terminal margins of thoracic fusion segment IV–V in lateral view symmetrical, rounded, neither side produced posteriad (figs. 2, 4).

Right side of genital segment with unique acuminate process and smaller, more posteroventral, digitiform process, both extending laterad (figs. 4, 5, 8). Genital boss prominent, asymmetrical, extending posteroventrad from right side as conspicuous lobiform process (figs. 4, 7, 8); in dorsal view process barely visible (fig. 5). Posterior ridge of genital orifice with short lateroventral processes (fig. 7). Anteroventral portion of genital segment with small rounded swelling anterior and left of genital boss (figs. 2, 7, 8).

ADULT MALE: Differs from *concinna* with respect to minute details of left fifth leg.

Left fifth leg with Re_2 slightly expanded at distal portion; distal portion bearing short thick hairs on lateral as well as medial margins, about five serrations on anterior portion of apex, and small cteniform row of hairs on remainder of apex (figs. 9, 10, 13). Base of terminal segment with two processes, somewhat as in *concinna* (vide Giesbrecht 1892: pl. 16, fig. 19), but proximal process smaller and ensiform, larger distal process with expanded basal portion and digitiform apex (figs. 9, 10, 13).

Types.—All deposited in United States National Museum. Female holotype, No. 99197, selected from material of *Alaska*, cruise 8, station 5; lat. 28°54′ N., long. 90°11′ W.; 13 February 1953; 3 m. depth of plankton tow. Paratypes: Nos. 99198–99202.

Further description.—Relation of rostrum and frontal organ similar in male and female, forming angle of approximately 90°; distal portion of rostrum curving moderately posteriad (fig. 1). CAR as well as length relations of both abdominal segments and six terminal segments of first antennae similar to those of *concinna*, calculated from Giesbrecht's (1892) description and figures.

Cephalic appendages as in *E. marina* (Prestandrea), except for first maxillae. First external lobe of first maxillae with four elongated setae, one short seta. Endopodite of second maxillae with one spinulated seta as in Sewell's (1947) provisional Species Group II.

First legs (figs. 15, 16) apparently as in *concinna*. Female second leg with proximal two external spines of Re_3 equal in size, larger than distal spine (fig. 11). Legs 3–4 with external spines of Re_3 of equal length. Left fifth leg of male with rudimentary endopodite.

Egg cluster in spawning females with five–eight eggs extending posteroventrad from genital boss in single layer, two eggs wide. Individuals of both sexes often with stalked ciliates fixed to posterior thoracic segments and abdomen as in *marina* but smaller in size.

Remarks.—In the new species, the female is readily separated from *concinna* by the following: (1) the acuminate process extending laterad from the right side of the genital segment, (2) the form of the genital boss, especially the right lobiform process, which in dorsal view barely protrudes beyond the lateral limit of the genital segment, and (3) the rounded terminal portions of thoracic fusion segment IV–V.

The new species also resembles *E. consimilis* Farran (Indo-Pacific region) and *E. murrayi* Sewell (Arabian Sea), the latter two known only from the female sex. It differs from *consimilis* in the same manner that distinguishes it from *concinna*. In contrast, *murrayi* could be confusing since its genital segment bears a weak protuberance at the midpoint of the right side and the terminal portions of thoracic fusion segment IV–V are rounded (Sewell 1947: text fig. 26A–D). However, in Sewell's species the protuberance is not acuminate, the genital boss is on the posterior half of the segment, and the right lobe adjacent to the genital orifice extends posteriad (ibid.). The genital segment, in particular the acuminate process extending laterad from its right side, appears to distinguish *paraconcinna* from all other species of the genus.

In the male, the new species is distinquished from *concinna* only with difficulty. Apparently, the two are best separated by the distal portion of Re_2 of the left fifth leg. According to both Giesbrecht (1892: pl. 16, fig. 19) and Scott (1909: pl. 19, fig. 27), this segment in *concinna* terminates

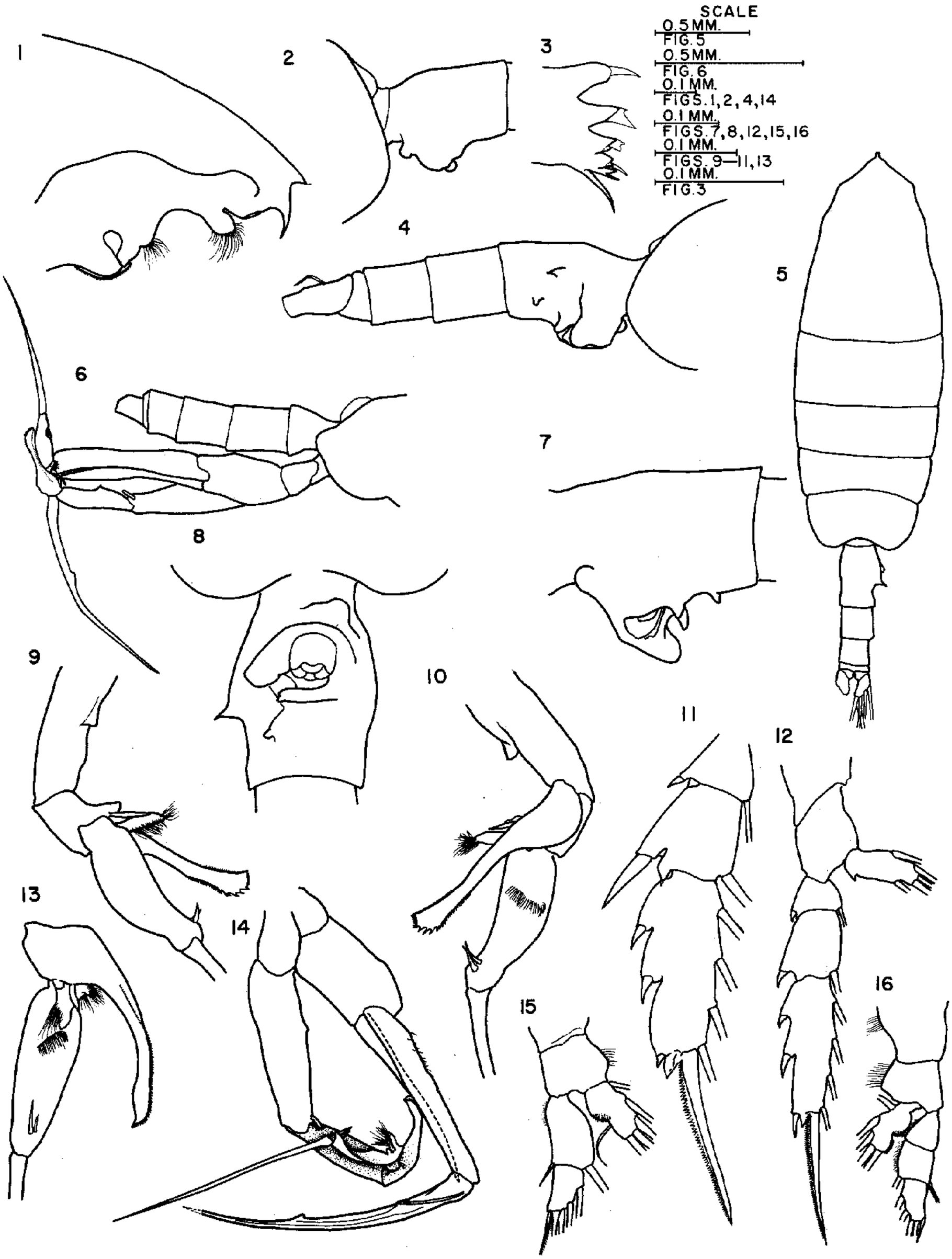

PLATE 2.—*Euchaeta paraconcinna*, new species. 1, female cephalon, lateral view; 2, female genital segment, lateral view; 3, female mandibular gnathal lobe; 4, female abdomen, lateral view; 5, female, dorsal view; 6, male abdomen, fifth legs, lateral view; 7, female genital segment, ventro-lateral view; 8, female genital segment, ventral view; 9, male left fifth leg, terminal segments, lateral view; 10, male left fifth leg, terminal segments, medial view; 11, female second leg, exopodite; 12, male second leg; 13, male left fifth leg, terminal segments, anterior view; 14, male fifth legs, posterior view; 15, female first leg; 16, male first leg. All figures drawn with aid of camera lucida; figure 4 of holotype, remaining figures of paratypes.

in one or two rows of long spinules, and the medial margin bears short lateral spinules. In all of the available *paraconcinna* males the apex of this segment bears a row of closely spaced fine hairs and the anterodistal corner is ornamented with five-six subequal serrations; the lateral margin is furnished with short hairs.

The male of *E. plana* Mori is also somewhat similar to the new species. From Mori's (1937) description, *plana* is distinguished from *paraconcinna* by the absence of Ri and presence of large spinules bordering Re_2 on the left fifth leg, and by the acute angle formed by the rostrum and the frontal organ.

I wish to thank Dr. Philip St. John (Brandeis University) for furnishing me with the records and specimens of the new species obtained by the *Atlantis* from the Cape Hatteras region.

Family STEPHIDAE

STEPHOS Scott

Stephos deichmannae, new species

PLATE 3, FIGS. 1–15

Localities, Material.—Gulf of Mexico: lat. 23°18′ N., long. 97°37′ W. (*Alaska*, cruise 2, station 11, 7 June 1951, 1 m. depth of plankton tow); lat. 29°06′ N., long. 93°00′ W. (*Alaska*, cruise 8, station 2, 12 February 1953, 6 m. depth of plankton tow). Material consisting of 22 adult females, 4 adult males, numerous immature copepodites; juveniles taken only at cruise 2, station 11.

Measurements.—Specimens measured from right lateral view at 100×, magnification; length of cephalothorax from imaginary line between anteriormost limit of forehead to posterodorsal margin of intersegmental membrane between thoracic fusion segment IV–V and genital segment; length of abdomen from anterodorsal margin of genital segment to posteriormost limit of right furcal ramus. Otherwise, methods are as presented under the first species described above.

1. ADULT FEMALE: 22 specimens, TL range 0.62–0.73 mm., mean with standard error 0.68±.006 mm., standard deviation 0.030 mm., CAR range 2.9–3.5:1, mean 3.2:1.

2. ADULT MALE: Four specimens: TL 0.61 mm., CAR 2.7:1; TL 0.66 mm., CAR 2.7:1; TL 0.66 mm., CAR 2.4:1; TL 0.62 mm., CAR 2.8:1.

Diagnosis.—A relatively small species somewhat resembling *S. scotti* Sars, *S. fultoni* Scott and Scott, and *S. gyrans* (Giesbrecht).

ADULT FEMALE: Differs from above species in details of thoracic fusion segment IV–V, genital segment, and fifth legs.

Terminal portions of thoracic fusion segment IV–V asymmetrical, in dorsal view left side extending more posteriad; in lateral view right side somewhat truncate and lacking spiniform process (fig. 3), left side extending posteroventrad in lobiform process (figs. 4, 7).

Genital segment in dorsal view with asymmetrical lateral swellings, swelling of left side larger, right side bearing one lateral spine (figs. 1, 7); occasionally two lateral spines present. Posterior margin of genital orifice with elongated spine, differing from that in *gyrans* and *fultoni;* spine relatively straight, midventral, and extending posteriad to approximate midlength of following segment (figs. 1, 3).

Fifth legs similar in form to those of *gyrans*, differing in spinal ornamentation; second segment with distal border bearing horizontal row of spinules; terminal segment with horizontal row of styliform spinules at approximate midlength, row of scalelike spinules on distal half of lateral margin, and fine hairs on medial margin (figs. 5, 9).

Types (*cf. Localities*).—All deposited in United States National Museum. Female holotype: No. 99186; selected from material of Alaska, cruise 8, station 2. Paratypes; No. 99187 (*Alaska*, cruise 8, station 2); No. 99188 (*Alaska*, cruise 2, station 11).

Further description.—Cephalon and thoracic segment I separated by weak suture as in *gyrans*. Ri of leg 1 with robust hemispherical shoulder bearing one spinule (fig. 13). Legs 2–4 with external spines of Re bearing minute serrations on distal border (figs. 10–12). Leg 4 approximately one-third longer than abdomen (fig. 3). First antennae in female about as long as combined lengths of cephalothorax and genital segment; antennal segments 1–2 partially fused, 8–9 completely fused. First antennae in male barely as long as cephalothorax. Cephalic appendages

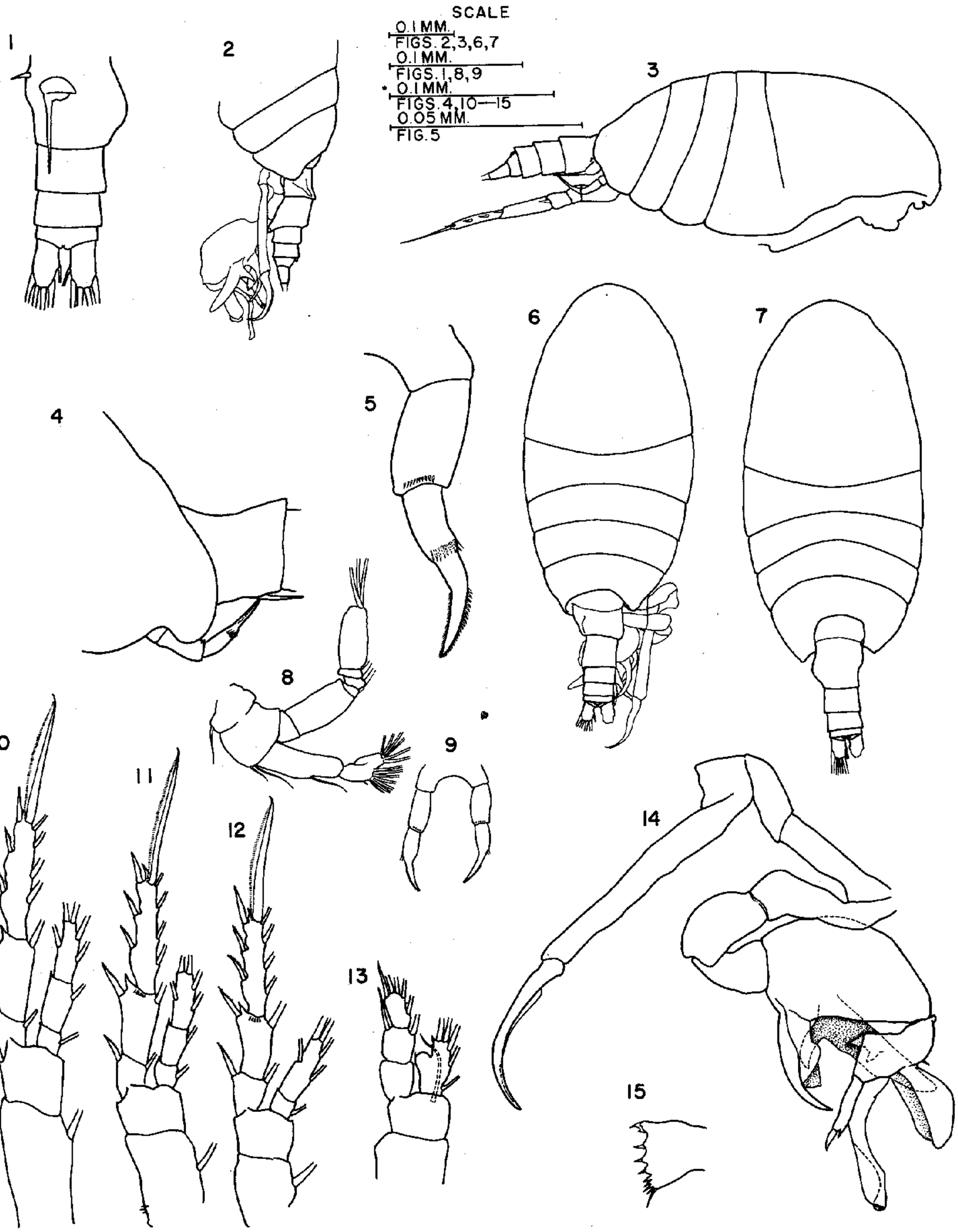

PLATE 3.—*Stephos deichmannae*, new species. 1, female abdomen, ventral view; 2, male posterior thoracic segments, abdomen, fifth legs, lateral view; 3, female, lateral view; 4, female left posterior thoracic margin, fifth legs, genital segment, lateral view; 5, female fifth leg; 6, male, dorsal view; 7, female, dorsal view; 8, female second antenna; 9, female fifth legs; 10, female fourth leg; 11, female third leg; 12, female second leg; 13, female first leg; 14, male fifth legs; 15, female mandibular gnathal lobe. All figures drawn with aid of camera lucida; figures 3, 7 of holotype, remaining figures of paratypes.

similar to those in *S. lamellatus* Sars (1902: pl. 42). Rostrum absent as in other species of genus.

ADULT MALE: Differs primarily in form of genital segment, second abdominal segment, and fifth legs.

Genital segment asymmetrical in dorsal view, left side extending farther laterad than right; left side in lateral view with oblique ridge (figs. 2, 6).

Second abdominal segment with left posteroventral portion produced in short hooked process (fig. 2); similar hooked process also typical of *S. arcticus* Sars.

Right fifth leg with terminal segment spiniform, distal half curved, proximal half straight, inner margin bordered by low lamella (fig. 14). Left fifth leg with penultimate segment tumid, proximal portion with falcate spiniform process and scooplike process, midportion with elongate lamelliform process bearing proximal spur; short terminal segment with apical rodlike process, subapical scooplike process, lateral scooplike process; anteromedial portion of terminal segment with two short thick spines (figs. 2, 6, 14).

Remarks.—In the female the new species is readily distinguished from previously described forms of the genus by (1) the greater length of the left side of thoracic fusion segment IV–V, (2) the asymmetrical laterial swellings of the genital segment, and (3) the straight midventral spine extending posteriad from the genital orifice.

In the male the new species is easily separated from the other species by (1) the spiniform terminal segment of the left fifth leg, and (2) the combination of scooplike, lamelliform, and spiniform processes extending from the tumid penultimate and terminal segments of the right fifth leg.

The new species is named in honor of Dr. Elizabeth Deichmann (Curator of Marine Invertebrates, M. C. Z., Harvard University) as an expression of my deep gratitude for her beneficial aid and patient understanding during the period of my graduate studies under her tutorage.

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